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Assessment of 4T American Plaice

by

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ABSTRACT

The provisional catch estimate of American plaice in NAFO Division 4T in 1987 is 7,794 t. The proportion of the total catch taken by seiners was 39%, a decrease from 48% in 1986. Bottom trawlers took 41% of the total catch. Landings by fixed gear increased to 19% of the catch from 13% in 1986. Ageing discrepancies were recognized for the years 1985 and 1986. Due to time constraints only the 1985-86 RV and 1986 commercial samples were re-aged. The revised ageing was used in this assessment. Standardized catch rates in the plaice directed, cod directed and combined fisheries showed stability in the plaice directed component and a decline in catch rates from the 1970s in the other two indices. RV mean numbers per tow in 1986 and 1987 were the lowest in the series. The average age 8-19 total mortality estimates from RV data were 0.37 for 1971-79 and 0.54 for 1980-1987. Fishing mortality during the 1980s is therefore above $F_{0.1}$. A Leap Frog projection gave a yield of 8600 t.

RESUME

Selon une estimation provisoire, les captures de plies canadiennes dans la division 4T de l'OPANO en 1987 ont été de 7 794 tonnes. Sur ce total, la proportion des captures à la senne est de 39 %, ce qui représente une baisse par rapport à 1986, puisqu'elle était alors de 48 %. Les captures au chalutage de fond représentent 41 % du total. Les débarquements des bateaux à engin fixe sont passés à 19 % des captures, de 13 % qu'ils étaient en 1986. On a constaté que les classements par âge de 1985 et 1986 présentent des divergences. En raison du manque de temps, il n'a été possible de revoir que le classement des échantillons de navires de recherches de 1985-1986 et des échantillons de pêche commerciale de 1986. C'est le nouveau classement qu'on a utilisé dans l'évaluation présentée ici. L'analyse des taux de capture uniformisés de plies, de morues et des pêches combinées révèle que la pêche à la plie est stable, tandis que les taux ont baissé depuis les années 1970 dans les deux autres cas. Les valeurs moyennes par trait de chalut fournies par les NR en 1986 et 1987 sont les plus basses de la série. Les estimations de la mortalité totale moyenne établies d'après les données des NR pour les classes d'âge de 8 à 19 donnent les valeurs suivantes : 0,37 de 1971 à 1979 et 0,54 de 1980 à 1987. Durant les années 1980, la mortalité par pêche a donc dépassé le $F_{0,1}$. D'après une projection saute-mouton (Leap-Frog), le rendement serait de 8 600 tonnes.

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INTRODUCTION

Since 1965 nominal catches taken from the 4T American plaice stock have varied from a high of 11,780 t in 1966 to a low of 6,094 t in 1983 (Table 1). A TAC of 10000 t has been imposed on the fishery since 1977. Annual landings have averaged over 1,000 t less than this. Catches for the last two years have been below 8,000 t.

Historically, the American plaice fishery was primarily a by-catch fishery of southern Gulf of St. Lawrence cod fishery. In recent years a fishery directed for American plaice has taken roughly half the total catch. The stock is exploited both by mobile gears, such as otter trawler, Danish and Scottish seines, and fixed gears including gillnets, longlines and handlines. The composition of gears has changed from mainly longlines from 1937 to 1946 to a mixed fishery of longlines, otter trawl and Danish seine from 1947 to 1963 (Powles 1969). Since 1965 most of the fishery has been prosecuted using otter trawls, Danish seines, longlines, and gillnets (Table 1). Danish seines have taken an increasing proportion of the total catch from 1965 to 1986 to become the dominant gear type. However, in 1987, the trawls (including pair-bottom trawls) took 41% of the catch compared to 39% for the seiners.

A) Nominal Catches and Description of the Fishery

Nominal catch for 1987 was calculated using the provisional data supplied by the Statistics Branches of the Scotia-Fundy, Newfoundland, Quebec and Gulf regions of the Department of Fisheries and Oceans. The provisional estimate of catch for 1987 is 7,794 t, slightly up from 1986 and only 77.9% of the TAC. Breakdowns of nominal catches by gear and month are presented in Table 2. Nominal catches of flatfish in the entire Gulf of St. Lawrence are shown in Table 3. The total flatfish catches are the highest recorded since 1979.

The proportion of the 4T plaice catch taken by Quebec increased from 35% of the total catch in 1986 to 44% in 1987 (Table 4). The Maritimes took virtually all the remaining catch. The proportion taken by Danish and Scottish seines decreased from 48% of the total catch in 1986 to 39% in 1987 (Table 1). Landings by fixed gear increased to 19% of the catch from 13% in 1986.

During 1987, as in 1986, there were no closures of the American plaice fishery in 4T (Table 5). The M.G. (<65') fishermen caught substantially less than their allocation of 8000 t. The M.G. (65'-100') fishermen exceeded their allocation by 20%. Closures in the cod fishery to protect young cod (See Chouinard and Sinclair 1988) may have impacted the fishing patterns of American plaice fishermen. The impact may have

occurred in two ways: 1) when the cod fishery was closed more vessels would be directed towards American plaice; 2) fishermen complained that they were forced to stop fishing groundfish altogether during the cod fishery closures because they quickly exceeded their cod by-catch when fishing for American plaice. This latter effect was most severe for the P.E.I. fishermen.

4T Plaice Biological Advice. 1977-87

The original TAC for this stock was estabished following the recommendations of the ad hoc working group on Gulf of St. Lawrence Groundfish Stock Assessment for 1977. This group met to consider those stocks for which ICNAF did not set TAC's and other stocks from which additional management measures were considered to be important (Halliday, pers comm). In terms of catch levels the working group noted estimates of fishing mortality (.46) from a study in the 1960s and the stable catches of around 10,000 t in the 1960s-70s. They concluded that the stock was probably being overexploited (Fmax=.3) but that there was no evidence that recruitment was being adversely affected. To quote from the document:

> Until a detailed analysis can be performed it is recommended that measures be taken to maintain the present situation. A TAC for 1978 of 10,000 m. tons is recommended. This is slightly above recent catches and would serve to prevent substantial new fishing effort being diverted to the fishery - a real possibility in view of the anticipated restrictions on redfish and cod fishing in the area.

Attempts were made at analytical assessments of the stock in 1978-1980 CAFSAC advisory documents. Estimates of discarding from a 1976 study were included in these analyses. In 1978 $F_{0.1}$ and F_{max} were estimated to be .16 and .30 respectively. Estimates of F_{max} indicate that catches of 10,000 t would approximate $F_{0.1}$. A cohort analysis was presented in 1979 using the same discard estimates "however, because of the very limited sampling data, the analysis was not considered to reflect adequately the events in the fishery". Length and age frequencies from research cruises and the commercial fishery showed little change in the fishery. CPUE was noted to be stable to 1975 with 15-20% per year increases since then. No change in the reference catch was recommended. The 1980 assessment was based on cohort analysis. $F_{0.1}$ was estimated as .2. The results indicated a reference catch for 1981 of 13,000 t, however, this was not implemented.

Since 1980 the assessments were based on review of CPUE and RV data only. In 1986 fishing mortality was estimated to be close to 0.4 using a catch curve, and $F_{0.1}$ was estimated to be 0.3. However, CAFSAC did not consider either this analysis or

any others since 1980 to warrant a change in the reference catch of 10,000 t.

In summary the original TAC recommendation in 1977 was pre-emptive in nature and was based on average catches slightly below 10,000 t - an indication of stability in the stock. This level was supported to a certain extent by analytical assessments in 1978-1980. This was a period of relatively high biomass for the stock. Since then there has been no basis to advise a change.

B) Information Relevant to the Assessment

i) Re-ageing

To establish criteria for age reading that would be consistent with those of the years 1971 to 1982, a workshop was held at the Gulf Fisheries Centre during 1987 (Tallman MS 1988). Once consistency with 1971 to 1982 age reading had been established, sub-samples of the 1983 to 1986 research survey and commercial otoliths were re-examined to determine if age reading was precise and without bias for these years. We attained less than 70% agreement with the historic reader for the years 1985 and 1986. As well, we found a bias in 1985 and 1986 suggesting that the otoliths were underaged and overaged, respectively. Therefore, all the 1985 and 1986 research vessel survey otoliths and the 1986 commercial otoliths used in the assessment were re-aged. These new readings were used in the recalculation of catch and average weight at age in 1986 and research vessel survey estimates in 1985 and 1986. Due to time constraints the 1985 commercial samples were not re-aged. Rather than using biased ages in assessment calculations we decided to use a Leap Frog method to calculate a TAC (Pope 1983). With this method 2 years of commercial catch-at-age data are sufficient. The procedures for calibration and age error checking used by the Gulf, MAFD cod program were applied throughout age reading (See Tallman MS 1988 and Chouinard et al. 1987 for further details). The results of age reader agreement tests during the age reading are shown in Table 6.

INPUT DATA

A) Commercial Fishery Data

i) Catch and Weight at Age

Sampling of the commercial fishery in 1986 and 1987 was comparable to previous years. Samples were taken from May to November corresponding to the period when 96% of the catch was taken. Over 19,000 fish were measured in both years (Table 7a and Table 7b). All available otoliths for these years were re-aged. This amounted to 1,292 ages for 1986 and 2,368 ages for 1987.

To make semi-annual age-length tables, the year was split into two parts: before and after July 31. This split provided the

best balance for the temporal aspects of the fishery which begins in April and generally closes by the end of November (Table 2).

As well, the partition provided the best balance of catch, ages and lengths sampled within the major gear types (Tables 2, 4, 5). We assumed that age at length was unaffected by gear sampled and combined otoliths within each half of the year to make the semi-annual keys.

The length frequencies by gear and semi-annual period weighted by the corresponding landings were used with the appropriate age-length table to obtain the catch at age by gear and half year period (Table 8). Sampled gears were grouped in the following categories: 1) otter trawls and PTB's; 2) seines; 3) gillnets and longlines. Unsampled catch was incorporated by multiplying the catch at age for sampled gears by the ratio the total catch over sampled landings.

Catch at age and its variance by gear and semi-annual period is presented in Tables 9 and 10.

Weights at age from 1986 and 1987 were determined using a length-weight relationship calculated from 1986 and 1987 survey data, respectively. In 1986 the parameter estimates for the power curve ($Y = a X^b$) were a = 0.004863 and b=3.181 for both sexes combined. In 1987 the parameters for the power curve were a = 0.000639 , b = 3.754 for the males and a = 0.002110, b = 3.401 for the females. The correlation coefficients for the above three regressions were 0.96, 0.93, 0.95, respectively. The weights at age for 1986 and 1987 are generally lower for mobile gear than for fixed gears (Table 12).

The combined catch at age for 1986 and 1987 is shown in Table 13. In 1987 fewer younger fish were caught relative to 1986. The increase in the fixed gear fishery may account for the shift between the years in catch at age.

Coefficients of variation (C.V.) for the numbers at age for 1987, where sexed length frequencies were used were reduced, compared to the C.V.'s for 1986 which were unsexed. A considerable reduction in the C.V. at age is attained by using sexed length frequencies compared to combined.

ii) Commercial Catch Rates

Separate catch rates were calculated for the plaice directed (1977-1987) and cod directed (1966-1987) fisheries as well as the two groups combined (1966-1987). Gears used were restricted to otter trawls and Danish seiners. The two gears account for over 85% of the nominal catch in the fishery and well over 95% of the available catch rate data (Table 1). The 1984-85 data were revised according to 1984 NAFO statistics and 1985 regional data respectively. Observations with less than 10 units of effort were removed. Months with less than 10 observations through the series were deleted in the combined run. A multiplicative model

was used to calculate a standardized catch rate index for each gear (Gavaris 1980).

Observations were allocated to categories of gear/tonnage class/NAFO country code, month and year in the plaice directed and cod directed runs. Observations in the combined run were allocated to categories of gear/tonnage class/NAFO country code, plaice or cod directed fishery, month, and year. In all runs country codes 27 and 28 (Maritimes and Quebec,respectively) were combined into code 2 (the former Maritimes-Quebec code).

The analysis of variance tables from the three runs are shown in Tables 14, 16, and 18. The plaice directed model accounted for 39% of the variation and each category was significant. The model accounted for 64% and 72% of the variation in the cod directed and combined runs and in each case all categories were significant. The regression coefficients also are shown in Tables 14, 16, 18. Plots of the residuals of each run are shown in Figures 1, 2 and 3. In each case the residuals appear to be randomly distributed.

Catch rate in all models increased from 1986 to 1987 but is well below historical catch rates of the late 1970s and 1960s (Tables 15, 17, 19) and Figures 4 and 5).

The residual distribution did not indicate heteroscedasticity, consequently weighting was not used.

B) Research Survey Data

In 1986, the research vessel E.E. Prince was replaced by the Lady Hammond to conduct the fall groundfish survey in the southern Gulf of St. Lawrence. A comparative fishing experiment between the two vessels had been conducted in the 1985 survey to determine conversion factors. CAFSAC recommended that the catch per tow of American plaice from the E.E. Prince be multiplied by a factor of 1.8 to be made comparable to current survey estimates from the Lady Hammond. The numbers at age for 1971 through to 1985 were adjusted by the conversion factor.

In addition to the change of survey vessels, a change was made to the survey design. In 1984 the random Stratified Station design was replaced by a fixed survey with non-random initial allocation of stations. For the period from 1984-87 the index was calculated from a set of stations consistent with previous daytime sets and only from stations occupied each year. A constant trawlable unit site was used for both vessels.

From 1984 to 1986 only unsexed length frequencies were taken. Sexed length frequencies were resumed in 1987.

The sum of the mean numbers per tow at age from 1971-1987 are shown in Figure 6. Mean numbers per tow at age are presented in Table 20. The pattern of the mean numbers per tow reflects the high abundance at the end of the 1970s. The numbers per tow for 1986 and 1987 are the lowest in the series.

The mean numbers per tow by strata are shown in Figure 7. The figure shows that American plaice occur in abundance in particular strata. The most notable are strata 19, 22, 23, 29, 33, 34. The pattern of distribution is relatively constant with time.

ESTIMATION OF PARAMETERS

A) Mortality Estimates from the RV Survey

Total mortality at age was calculated as the negative ln ratio of consecutive estimates for each cohort (Table 21). While these were variable from year to year there were generally higher total mortalities in the 1980s than in the 1970s as indicated by averages in Table 22. Also the total mortalities at age increased to about age 8 but were relatively constant to age 19. Estimates of older age abundance are not available at this time. The average age 8-19 values of Z were 0.37 for 1971-79 and 0.54 for 1981-87. $F_{0.1}$ for this stock is estimated to be 0.2. Assuming M = 0.2 fishing mortalities are above the target in recent years.

B) Leap Frog

Given two years of catch at age a Leap Frog projection (Pope 1983) was attempted. The recent trends in both C/E and RV mean numbers per tow indicate relative stability for the stock, and the recent catches have also been stable. Therefore it was concluded that over the past two years fishing effort had also been stable.

The results of the projection to 1988 are shown in Table 23. The ln catch ratios used in the calculation are also given. These indicate that for ages 16+ and the same year-class more fish were taken in 1987 than in 1986. This indicates a possible shift in the PR in the two years and consequently reduces the utility of a Leap Frog.

The projected 1988 yield using this method was 8,600 t.

PROGNOSIS

Average catch in the 1980s was 8,000 t. F during that period was above $F_{0.1}$. CPUE and RV indices suggest the the stock size has diminished from the levels in the 1970s. A TAC of 8,000 t is likely to be closer to an $F_{0.1}$ catch level than 10,000 t.

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Table 1. Nominal catches (t) of 4T American plaice from 1965-1987 by major gear types.

YEAR	OTB	OTB-1	OTB-2	SNU	GN	LL	LHP	OTHERS	TOTAL
1965	7782	-	-	1854	388	212	-	149	10385
1966	-	8066	581	2322	375	2	-	434	11780
1967	-	7237	211	1151	326	117	50	259	9351
1968	-	7900	237	913	298	4	36	180	9568
1969	-	5609	425	1418	421	58	17	244	8192
1970	29	5793	477	2243	439	79	7	134	9201
1971	-	4996	409	2885	876	21	9	317	9513
1972	14	4275	860	2576	286	73	11	199	8294
1973	20	3087	471	2748	241	73	1	406	7047
1974	0	3556	585	3719	250	6	5	364	8485
1975	1	3207	795	3897	217	14	18	294	8443
1976	41	4097	2864	3395	225	2	6	562	11192
1977	35	4261	375	4015	242	16	17	359	9320
1978	58	3651	889	3495	379	42	38	479	9031
1979	83	3415	961	3719	721	9	17	1161	10086
1980	1485	1809	558	3500	717	55	5	163	8292
1981	1022	1311	290	3575	1084	98	2	452	7834
1982	742	580	137	4124	805	94	5	55	6542
1983	821	479	102	4095	494	76	10	17	6094
1984	235	601	2582	3702	1905	386	25	191	9627
1985	165	824	3027	3870	1007	404	29	164	9490
1986*	0	704	1925	3462	609	317	45	151	7213
1987*	0	986	2057	3078	800	619	73	181	7794
AVERAGE	696	3475	905	3033	570	121	20	301	8816

* (PROVISIONAL DATA)

(Gear Types: OTB = Otter Trawl, OTB1 = Otter Trawl-Side, OTB2 = Otter Trawl-Stern, SNU = Seines, GN = Gillnet, LL = Longline, LHP = Hand Line)

TABLE 2. Preliminary Landings (t) for 1987 by gear and month.

	MONTH												
GEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
OTB1	0.0	0.0	-	157.5	236.0	111.6	37.9	179.2	73.5	52.8	137.5	-	986.0
OTB2	0.6	0.0	-	85.5	379.3	390.3	235.8	352.9	203.6	298.3	109.8	1.1	2057.2
PTB	-	-	-	38.6	10.1	11.7	11.2	17.7	25.2	4.9	6.5	-	125.9
TXS	-	-	-	2.4	4.7	1.2	15.4	24.5	-	2.2	3.4	-	53.8
SDN	0.0	-	0.5	30.7	323.0	587.8	445.0	496.7	267.4	275.8	308.1	6.2	2741.2
SSC	-	-	-	2.1	46.7	28.0	7.3	28.9	9.0	12.6	10.8	-	145.4
PS	-	-	-	0.0	0.2	31.1	35.4	60.7	22.1	41.8	-	-	191.3
GNS	0.0	-	0.0	11.2	117.4	175.8	157.5	17.2	93.3	67.8	0.2	-	300.4
LLS	-	-	-	0.4	49.4	119.2	192.1	135.0	38.3	66.9	15.8	1.4	618.5
LHP	-	-	-	0.0	0.0	0.1	3.9	0.4	0.0	0.0	0.0	-	4.4
HL	-	-	-	0.0	1.8	7.2	13.8	36.3	5.3	4.1	0.0	0.0	68.5
FPN	0.3	1.2	0.1	0.0	0.0	0.0	0.0	0.0	-	-	-	-	1.6
TOT	0.9	1.2	0.6	328.4	1168.6	1464.0	1155.3	1509.5	737.7	827.2	592.1	8.7	7794.2

* Values of 0.0 indicate landings of less than 50kg.

- indicates no landings

(Gear Types: OTB = Otter Trawl, OTB1 = Otter Trawl-Side, OTB2 = Otter Trawl-Stern, PTB = Pair Trawl Bottom, TXS = Shrimp Trawl, SDN = Danish Seine, SSC = Scottish Seine, PS = Pair Seine, GNS = Gillnet Set, LLS = Longline, LHP = Hand line, HL = Hand lines, FPN = Pound nets)

Table 3. Commercial flatfish nominal catches (t) in NAFO Division 4RST from 1963 to 1987

YEAR	YELLOW TAIL	ATLANTIC HALIBUT	GREEN. HALIBUT	WITCH	WINTER FLOUNDER	AMER. PLAICE	UNSPEC. FLOUNDER	TOTAL FLATFISH
1963	107	537	-	4250	3165	8470	-	16529
1964	65	615	-	3350	3014	8803	9	15856
1965	53	693	24	3608	4419	11098	5	19900
1966	157	612	365	3712	3136	12720	-	20702
1967	79	460	365	2714	2454	10497	24	16593
1968	12	444	689	3390	551	11932	-	17018
1969	268	510	802	4763	1710	10978	-	19031
1970	59	509	1112	4805	2694	13234	-	22413
1971	40	454	954	3821	2842	11770	-	19881
1972	3	310	683	2001	1911	9724	1373	16005
1973	6	385	763	2224	2384	8149	2426	16337
1974	27	418	1011	3247	1976	11261	999	18939
1975	3	272	1544	2722	2050	10177	3951	20719
1976	37	196	2019	6875	2471	14265	1785	27648
1977	30	150	3961	3036	1358	12755	1995	23285
1978	13	135	6247	4510	1236	12375	1196	25712
1979	69	132	8791	4561	1722	12933	894	29102
1980	46	202	7006	3527	2053	11115	1163	25112
1981	14	95	3176	1912	2013	10210	532	17952
1982	6	91	2269	1282	2339	8092	479	14558
1983	50	174	1105	1177	1799	8382	792	13479
1984	82	176	2126	1107	178	11790	65	15524
1985	212	164	2364	1824	1883	11366	2	17815
*1986	409	437	6533	1139	3144	8897	-	20559
*1987	410	234	11047	2568	2263	9599	-	26121
AVERAGE	91	336	2824	3125	2191	11528	1041	19872

(*1986 AND 1987 PROVISIONAL DATA)

Table 4. The 1987 provisional Gulf flatfish nominal catches (t) by NAFO division and provinces (see Figure 8).

	COUNTRY CODE	YELLOW TAIL	ATLANTIC HALIBUT	GREENLAND HALIBUT	WITCH	WINTER FLOUNDER	AMERICAN PLAICE
4R	CAN-M	1.1	2.2	10.0	64.0	3.7	51.4
	CAN-Q	0.0	0.6	3.0	5.1	0.0	13.8
	CAN-N	3.8	53.7	196.0	769.1	493.0	849.0
TOTAL 4R		4.9	56.5	209.0	838.2	496.7	914.2
4S	CAN-M	0.0	6.3	6.0	23.7	0.3	156.8
	CAN-Q	1.7	47.8	4390.0	8.7	10.9	733.3
	CAN-N	0.0	0.0	0.0	0.0	0.0	0.5
TOTAL 4S		1.7	54.1	4396.0	32.4	11.2	890.6
4T	CAN-M	185.5	25.7	173.0	1088.9	1387.1	4350.4
	CAN-Q	217.9	97.7	6269.0	608.6	368.0	3426.7
	CAN-N	0.0	0.0	0.0	0.2	0.0	17.0
TOTAL 4T		403.4	123.4	6442.0	1697.7	1755.1	7794.1

(CAN-M = CANADA-MARITIMES, CAN-Q = CANADA-QUEBEC, CAN-N = CANADA-NEWFOUNDLAND)

Table 5. Resource allocation scheme for American plaice in Division 4T 1986-1988.

Year	Gear	Final Allocation (tonnes)	Catch (tonnes)	Closure
1986	M.G. (65-100')	500	306	none
	M.G. (less than 65')	8000	6060	none
	F.G. (less than 65')	1500	1071	none
1987	M.G. (65-100')	500	602	none
	M.G. (less than 65')	8000	5908	none
	F.G. (less than 65')	1500	1498	none
1988*	M.G. (65-100')	500		
	M.G. (45'-65')	3800		
	M.G. (less than 45')	4200		
	F.G. (less than 45')	1500		

Table 6. Summary of age determination comparisons conducted during the age reading of the 1985-97 RV and 1986-87 commercial otoliths. (+ or - indicates bias).

Date (1988)	Comparison (% agreement)		
	Reader 1 v Reference	Reader 2 vs Reference	Reader 1 vs Reader 2
Jan 18	72		
Jan 25	82		
Feb 13	75 (-)		
Feb 23	76		
Feb 27	80		
Mar 10	74 (+)		
Mar 14	75	76	75
Mar 28	78	81	83
Apr 05	74	76 (-)	77

TABLE 7a NUMBERS MEASURED AND AGED FOR AMERICAN PLAICE IN 1986

		DATE							ALL
		MAY	JUNE	JULY	AUGUST	SEPT	OCT	NOV	
GEAR		SUM	SUM	SUM	SUM	SUM	SUM	SUM	SUM
OTB-1	AGED	.	.	108	.	32	65	.	205
	LENGTH	.	.	926	.	468	491	.	1885
OTB-2	AGED	31	31	44	45	30	0	0	181
	LENGTH	259	365	879	1491	746	192	145	4077
PTB	AGED	.	.	.	.	.	38	.	38
	LENGTH	.	.	.	.	.	251	.	251
SNU	AGED	91	58	250	62	89	25	16	591
	LENGTH	1244	2478	3580	1014	1486	1137	264	11203
LL	AGED	0	46	144	46	10	31	.	277
	LENGTH	287	338	570	495	15	79	.	1784
ALL	AGED	122	135	546	153	161	159	16	1292
	LENGTH	1790	3181	5955	3000	2715	2150	409	19200

TABLE 7b NUMBERS MEASURED AND AGED FOR AMERICAN PLAICE IN 1987

		DATE							ALL
		MAY	JUNE	JULY	AUGUST	SEPT	OCT	NOV	
GEAR		SUM	SUM	SUM	SUM	SUM	SUM	SUM	SUM
OTB-1	AGED	35	.	0	.	52	.	.	87
	LENGTH	369	.	251	.	251	.	.	871
OTB-2	AGED	36	69	.	28	64	56	71	324
	LENGTH	495	517	.	273	701	846	495	3327
PTB	AGED	.	.	.	.	.	19	.	19
	LENGTH	.	.	.	.	.	180	.	180
SNU	AGED	104	332	280	266	143	361	137	1623
	LENGTH	1090	2416	2122	1631	748	2246	1067	11320
GN	AGED	36	.	31	64	30	34	.	195
	LENGTH	206	.	962	760	250	250	.	2428
LL	AGED	.	.	0	59	.	25	36	120
	LENGTH	.	.	252	505	.	243	170	1170
ALL	AGED	211	401	311	417	289	495	244	2368
	LENGTH	2160	2933	3587	3169	1950	3765	1732	19296

Table 8. Age-length tables used in the calculation of the 1986 and 1987 catch at age.

YEAR	TABLE TYPE **	GEARS *	PERIOD		SAMPLE SIZE	CATCH
1986	TABLE	ALL GEARS	JAN-JUL	L	11479	3961
				A	803	
	TABLE	ALL GEARS	AUG-DEC	L	8274	3252
				A	489	
	LF	(11,12,16)	JAN-JUL	L	2429	1524
	LF	(20)	JAN-JUL	L	7302	1921
	LF	(50)	JAN-JUL	L	1195	513
	LF	(11,12,16)	AUG-DEC	L	3784	1178
	LF	(20)	AUG-DEC	L	3901	1542
	LF	(50)	AUG-DEC	L	589	458
1987	TABLE	ALL GEARS	JAN-JUL	L	8680	4119
				A	923	
	TABLE	ALL GEARS	AUG-DEC	L	10616	3675
				A	1445	
	LF	(11,12,16)	JAN-JUL	L	1632	1706
	LF	(20)	JAN-JUL	L	5628	1538
	LF	(40&50)	JAN-JUL	L	1420	851
	LF	(11,12,16)	AUG-DEC	L	2746	1473
	LF	(20)	AUG-DEC	L	5692	1540
	LF	(40&50)	AUG-DEC	L	2178	692

* gear codes: 11 = OTB-1, 12 = OTB-2, 16 = PTB, 20 = SNU, 40 = GN, 50 = LL and HL.

** TABLE TYPE: TABLE = A FULL AGE-LENGTH KEY
LF = LENGTH FREQUENCY USED WITH ALL GEARS AGE-LENGTH KEY

Table 9. Catch at age (,000) by gear and time period for 1986 and time period for 1986 and 1987.

	YEAR											
	1986						1987					
	JAN-JULY			AUG-DEC			JAN-JULY			AUG-DEC		
AGE	OTB	SNU	GN/LL	OTB	SNU	GN/LL	OTB	SNU	GN/LL	OTB	SNU	GN/LL
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.2	0.0	0.0
5	9.2	4.3	0.8	2.7	3.5	0.0	1.2	5.0	0.2	22.5	18.2	0.1
6	105.3	230.3	0.5	41.9	34.3	0.0	5.5	10.0	0.8	63.7	57.8	0.6
7	175.2	401.2	2.3	86.9	83.3	0.0	55.9	55.4	4.5	174.7	180.0	9.9
8	407.0	614.2	7.2	134.2	125.1	0.3	46.8	56.3	4.3	187.2	215.2	14.4
9	256.2	512.6	11.4	202.5	223.7	1.8	66.5	63.8	9.3	187.8	224.6	18.8
10	281.7	401.8	19.9	198.1	233.1	2.4	166.4	122.3	24.3	190.4	247.2	38.9
11	350.0	523.3	31.9	228.8	239.4	8.6	163.1	99.2	31.0	188.4	246.8	51.5
12	395.7	584.4	47.8	300.4	293.5	13.3	221.4	110.8	61.9	182.3	235.9	50.5
13	379.9	441.3	51.9	265.6	308.3	34.1	314.7	156.4	100.0	184.9	242.9	89.2
14	279.3	332.6	63.6	161.6	200.1	31.9	265.4	124.9	114.2	177.4	201.2	95.8
15	221.6	227.3	68.4	122.2	174.2	40.2	273.2	136.3	132.9	139.6	184.8	85.6
16	111.9	100.5	56.6	110.4	163.0	58.2	171.4	121.2	105.8	104.8	117.5	74.4
17	70.6	61.8	44.9	67.7	93.3	35.0	160.7	123.3	105.9	112.6	91.8	65.7
18	37.0	35.5	27.6	26.3	38.1	18.4	52.3	64.7	35.7	76.7	65.3	40.5
19	28.6	28.8	26.9	27.1	37.9	22.2	55.2	60.9	38.1	67.8	55.5	35.9
20	20.6	19.9	16.7	23.2	38.0	25.4	56.3	87.9	34.6	51.0	39.5	24.3
21	9.9	9.8	14.6	24.3	39.0	28.1	28.6	42.3	22.0	31.1	26.3	12.6
22	3.5	7.3	5.6	3.4	7.8	5.5	17.0	39.5	8.2	25.1	20.1	8.0
23	2.7	2.5	3.7	6.0	12.0	5.8	11.8	27.2	7.4	19.1	15.3	6.0
24	1.4	1.4	2.0	1.9	5.6	4.0	8.0	18.3	3.3	7.1	5.7	2.7
25	1.8	1.7	2.6	0.0	0.0	0.2	2.6	7.0	1.8	5.7	5.2	1.8
26	0.6	1.5	0.4	0.4	1.4	1.2	5.6	11.4	2.7	2.3	3.2	0.5
27	0.2	0.4	0.3	0.0	0.0	0.0	0.1	3.9	0.2	0.6	0.7	0.2
28	0.5	1.0	0.2	0.0	0.0	0.0	1.7	5.3	0.5	2.6	1.9	0.6
29	0.6	1.4	1.8	1.6	2.1	2.2	0.1	2.3	0.0	0.9	0.9	0.3
30	0.7	1.4	1.1	1.5	4.7	2.8	0.0	0.7	0.0	0.5	1.0	0.1
	3151.7	4548.2	510.7	2038.7	2361.4	341.6	2151.5	1556.8	849.6	2207.0	2504.5	728.9

Table 10. Variance of catch at age (millions) by gear and time period for 1986 and 1987

	YEAR											
	1986				1987							
	JAN-JUL			AUG-DEC			JAN-JUL			AUG-DEC		
AGE	OTB	SNU	GG/LL	OTB	SNU	GN/LL	OTB	SNU	GG/LL	OTB	SNU	GN/LL
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	8	15	0	4	5	0	4	2	1	31	39	3
6	1580	3180	41	147	197	4	17	8	3	98	123	11
7	2530	5085	66	351	472	11	128	63	21	293	366	33
8	3407	6813	91	493	661	16	106	52	17	370	469	41
9	3007	6058	79	913	1224	29	153	77	24	373	472	41
10	1918	3854	50	899	1206	28	352	175	56	408	519	45
11	2629	5287	68	997	1336	30	358	182	56	406	515	44
12	2711	5430	70	1171	1566	37	502	254	78	394	501	43
13	1683	3362	44	1179	1580	35	681	338	105	365	463	40
14	1352	2708	36	752	1009	22	639	321	99	304	384	35
15	675	1346	19	560	751	17	677	340	107	273	345	31
16	190	374	6	504	677	17	484	245	77	154	192	17
17	90	177	3	307	412	10	461	232	73	127	157	14
18	54	106	2	112	150	3	179	90	28	85	106	9
19	28	52	1	95	128	3	176	90	28	71	88	8
20	24	46	1	113	151	4	193	96	30	45	55	5
21	6	10	0	94	127	3	104	52	16	25	31	3
22	3	5	0	10	13	0	66	32	10	18	22	2
23	1	3	0	19	26	1	49	25	8	13	17	1
24	1	1	0	4	5	0	30	15	5	6	7	1
25	1	2	0	0	0	0	11	5	2	4	4	0
26	1	1	0	1	1	0	22	11	3	2	2	0
27	0	0	0	0	0	0	1	1	0	0	0	0
28	1	1	0	0	0	0	6	3	1	1	2	0
29	1	1	0	5	7	0	1	0	0	0	0	0
30	1	1	0	5	7	0	0	0	0	0	0	0
*	1442	1237	87	550	549	72	1360	132	154	862	631	84

* overall mean

Table 11. mean length at age (cm) by gear and time period for 1986 and 1987.

	YEAR											
	1986						1987					
	JAN-JUL			AUG-DEC			JAN-JUL			AUG-DEC		
AGE	OTB	SNU	GN/LL	OTB	SNU	GN/LL	OTB	SNU	GN/LL	OTB	SNU	GN/LL
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	21.0	0	24.0	24.0	0
5	27.2	35.3	55.6	27.5	26.5	0	30.8	29.2	30.2	29.3	30.7	32.3
6	28.8	30.5	33.1	30.8	31.0	33.0	35.3	30.2	33.1	30.6	31.3	32.2
7	31.8	31.7	34.9	32.2	32.3	33.0	34.8	32.3	34.5	32.4	33.2	37.2
8	30.5	31.8	36.4	32.6	33.1	40.6	35.0	32.3	34.5	33.6	33.9	37.4
9	34.0	32.8	39.1	34.2	34.8	45.0	35.5	33.3	37.6	33.8	34.3	37.7
10	35.2	34.2	41.1	34.9	35.2	46.1	36.5	35.0	40.0	35.4	35.8	39.5
11	35.7	34.2	41.8	37.6	37.7	43.1	37.7	36.0	40.2	36.1	36.6	40.5
12	36.9	34.2	42.7	37.7	37.9	44.5	39.5	38.6	42.9	36.7	36.9	41.0
13	37.7	36.4	43.3	38.9	39.8	47.0	40.3	40.0	43.4	38.7	38.8	42.1
14	39.0	37.2	44.7	39.9	41.5	48.2	42.2	42.4	44.6	42.0	40.9	44.1
15	40.1	39.2	46.7	42.6	43.4	49.0	43.3	44.6	45.3	42.2	41.1	43.4
16	42.9	42.5	47.4	44.1	45.4	51.4	46.6	49.3	47.5	46.0	44.2	45.0
17	44.3	44.6	48.5	43.6	44.8	51.1	47.4	50.5	47.8	48.7	47.0	47.5
18	45.1	45.5	49.0	47.3	48.3	52.3	50.9	52.8	50.5	49.9	48.6	48.0
19	47.9	48.9	51.0	48.2	49.9	53.3	49.5	52.8	49.2	50.6	49.5	48.1
20	45.9	48.6	51.5	49.8	49.8	52.8	52.6	54.9	50.9	51.9	52.2	50.2
21	52.5	54.1	53.1	51.1	51.8	54.9	51.2	54.4	50.4	53.0	54.7	51.9
22	56.0	59.6	57.9	56.5	57.2	56.4	54.8	56.4	54.4	54.5	55.6	52.6
23	51.2	52.2	51.3	52.6	54.4	57.7	54.6	55.7	53.1	54.3	56.4	53.9
24	54.4	55.3	54.7	61.4	60.4	60.6	55.0	57.4	53.9	53.1	54.3	51.7
25	53.5	54.8	53.2	0	0	66.0	52.2	57.8	53.4	55.6	57.5	54.7
26	63.4	61.6	60.9	60.0	60.0	60.0	54.3	55.8	54.0	57.2	59.7	56.5
27	63.0	63.0	63.0	0	0	0	63.6	64.2	62.3	58.8	59.6	58.3
28	63.4	62.4	61.0	0	0	0	58.1	60.5	59.5	56.0	57.9	56.2
29	56.0	57.4	57.7	52.0	52.0	52.0	63.7	63.7	63.0	58.5	58.5	58.5
30	57.6	59.0	57.6	58.2	58.5	58.6	0	65.0	0	63.7	63.7	62.4
*	36.0	34.7	46.1	38.2	39.6	50.8	42.2	44.1	45.8	39.4	38.8	44.1

* overall mean

Table 12. Mean weight at age (kg) by gear and time period for 1986 and 1987.

	YEAR											
	1986						1987					
	JAN-JUL			AUG-DEC			JAN-JUL			AUG-DEC		
AGE	OTB	SNU	GN/LL	OTB	SNU	GN/LL	OTB	SNU	GN/LL	OTB	SNU	GN/LL
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0.07	0	0.1	0.10	0
5	0.22	0.68	1.74	0.19	0.16	0	0.25	0.21	0.23	0.21	0.25	0.29
6	0.23	0.26	0.33	0.27	0.27	0.33	0.39	0.24	0.33	0.24	0.26	0.29
7	0.30	0.30	0.40	0.31	0.31	0.33	0.38	0.30	0.37	0.30	0.32	0.48
8	0.28	0.30	0.46	0.33	0.34	0.64	0.39	0.30	0.38	0.34	0.35	0.49
9	0.38	0.33	0.58	0.38	0.40	0.91	0.41	0.33	0.51	0.35	0.36	0.49
10	0.43	0.39	0.69	0.40	0.42	0.97	0.45	0.40	0.64	0.41	0.42	0.58
11	0.45	0.38	0.73	0.52	0.52	0.78	0.51	0.43	0.62	0.44	0.46	0.64
12	0.49	0.39	0.77	0.53	0.54	0.87	0.60	0.56	0.78	0.47	0.48	0.67
13	0.52	0.47	0.82	0.59	0.63	1.03	0.64	0.65	0.82	0.57	0.56	0.73
14	0.59	0.51	0.89	0.65	0.74	1.13	0.75	0.79	0.89	0.77	0.69	0.86
15	0.65	0.61	1.02	0.78	0.83	1.18	0.82	0.92	0.94	0.77	0.69	0.82
16	0.80	0.78	1.07	0.89	0.97	1.37	1.06	1.27	1.10	1.01	0.88	0.92
17	0.88	0.91	1.15	0.87	0.93	1.35	1.12	1.38	1.13	1.21	1.10	1.10
18	0.93	0.98	1.19	1.08	1.15	1.47	1.41	1.58	1.35	1.32	1.22	1.15
19	1.13	1.21	1.34	1.16	1.28	1.54	1.3	1.60	1.25	1.38	1.30	1.16
20	1.01	1.23	1.40	1.26	1.26	1.49	1.58	1.81	1.40	1.50	1.54	1.33
21	1.46	1.61	1.51	1.39	1.45	1.69	1.44	1.77	1.35	1.60	1.81	1.50
22	1.80	2.19	2.02	1.88	1.94	1.86	1.78	1.97	1.74	1.76	1.91	1.57
23	1.35	1.44	1.35	1.54	1.70	2.00	1.77	1.90	1.60	1.73	1.99	1.68
24	1.62	1.71	1.65	2.38	2.26	2.28	1.82	2.10	1.70	1.63	1.76	1.48
25	1.56	1.68	1.52	0	0	2.98	1.51	2.16	1.63	1.89	2.11	1.79
26	2.63	2.41	2.31	2.20	2.20	2.20	1.73	1.89	1.69	2.07	2.40	1.97
27	2.57	2.57	2.57	0	0	0	2.96	3.05	2.74	2.24	2.34	2.17
28	2.62	2.50	2.32	0	0	0	2.17	2.49	2.35	1.90	2.13	1.93
29	1.77	1.91	1.95	1.40	1.40	1.40	2.98	2.94	2.84	2.20	2.20	2.19
30	1.97	2.12	1.97	2.01	2.04	2.04	0	3.15	0	2.95	2.94	2.75
*	0.48	0.42	1.00	0.58	0.65	1.34	0.79	0.99	1.00	0.67	0.61	0.88

* overall mean

Table 13. Estimated 1986 and 1987 catch at age (,000), cv, mean weight, and mean length for 4T plaice.

	1986				1987			
AGE	CATCH	CV	WEIGHT	LENGTH	CATCH	CV	WEIGHT	LENGTH
4	-	-	-	-	1	0.000	0.077	21.9
5	21	0.273	0.362	30.0	48	0.188	0.226	29.9
6	417	0.172	0.254	30.2	139	0.116	0.258	31.1
7	757	0.122	0.300	31.9	483	0.062	0.323	33.1
8	1302	0.082	0.301	31.6	527	0.062	0.346	33.8
9	1221	0.087	0.366	33.8	574	0.059	0.367	34.4
10	1149	0.078	0.414	34.9	794	0.050	0.437	36.1
11	1397	0.073	0.455	36.0	784	0.050	0.479	37.0
12	1653	0.063	0.482	36.5	868	0.049	0.551	38.4
13	1497	0.059	0.564	38.4	1094	0.041	0.637	40.1
14	1081	0.071	0.635	39.7	984	0.043	0.774	42.4
15	863	0.067	0.748	41.8	958	0.044	0.818	43.2
16	607	0.069	0.940	45.0	699	0.049	1.050	46.5
17	377	0.084	0.971	45.5	664	0.049	1.180	48.2
18	185	0.112	1.102	47.5	337	0.066	1.348	50.2
19	173	0.101	1.268	49.8	315	0.068	1.352	50.2
20	145	0.127	1.278	49.8	295	0.07	1.588	52.7
21	127	0.122	1.516	52.7	164	0.093	1.609	52.9
22	33	0.166	1.976	57.5	118	0.103	1.845	55.3
23	33	0.215	1.636	53.9	87	0.122	1.818	55.0
24	16	0.202	2.098	58.9	45	0.176	1.867	55.3
25	6	0.271	1.622	54.1	24	0.211	1.947	56.0
26	5	0.370	2.313	60.9	26	0.245	1.917	55.9
27	1	0.000	2.574	63.0	6	0.253	2.844	62.9
28	2	0.822	2.523	62.6	13	0.284	2.237	58.6
29	10	0.385	1.596	54.1	5	0.220	2.593	61.3
30	12	0.305	2.033	58.4	2	0.000	3.006	64.1

Table 14. ANOVA and coefficient estimates from the plaice directed catch rate standardization.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.623
MULTIPLE R SQUARE...0.388

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	6.196E0002	6.196E0002	
REGRESSION	30	3.709E0001	1.236E0000	5.357
TYPE 1	12	1.421E0001	1.184E0000	5.131
TYPE 2	8	8.934E0000	1.117E0000	4.839
TYPE 3	10	6.346E0000	6.346E-001	2.750
RESIDUALS	254	5.862E0001	2.308E-001	
TOTAL	285	7.153E0002		

TYPE 1 - GEAR, TONNAGE CLASS, COUNTRY
TYPE 2 - MONTH
TYPE 3 - YEAR

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD.ERROR	NO.OBS
1	2114	INTERCEPT	-1.861	0.307	285
2	5				
3	77				
1	2223	1	0.427	0.314	16
	3113	2	1.460	0.456	2
	27213	3	0.542	0.297	65
	27222	4	0.351	0.412	3
	28111	5	0.071	0.460	2
	28112	6	-0.335	0.320	14
	28113	7	0.521	0.297	34
	28121	8	0.224	0.349	8
	28122	9	0.629	0.331	10
	28123	10	0.614	0.301	33
	28211	11	0.137	0.347	8
	28212	12	0.374	0.297	87
2	4	13	0.193	0.138	23
	6	14	-0.077	0.115	37
	7	15	-0.315	0.115	37
	8	16	-0.222	0.115	37
	9	17	-0.305	0.112	42
	10	18	-0.125	0.113	39
	11	19	0.079	0.122	30
	12	20	0.725	0.261	4
3	78	21	0.130	0.120	29
	79	22	0.266	0.112	37
	80	23	0.176	0.122	29
	81	24	0.274	0.125	25
	82	25	0.072	0.156	14
	83	26	0.059	0.149	16
	84	27	-0.249	0.129	25
	85	28	-0.002	0.261	4
	86	29	-0.155	0.134	24
	87	30	0.055	0.121	40

CODE: LAST TWO DIGITS EQUAL GEAR TYPE (10 - 19 ARE TRAWLERS, 20 - 29 ARE SEINERS) NEXT FROM THE LEFT EQUALS TONNAGE CLASS, THE FOURTH AND FIFTH DIGITS FROM THE LEFT ARE COUNTRY CODES.

Table 15. Standardized catch rate for plaice directed fishery

PREDICTED CATCH RATE

standards used variable numbers: 2114 5

YEARS	TOTAL CATCH	PROP.	CATCH RATE MEAN	S.E.	EFFORT
77	9320	0.446	0.166	0.05	55977
78	9031	0.361	0.189	0.059	47805
79	10086	0.279	0.218	0.064	46336
80	8292	0.206	0.198	0.061	41887
81	7834	0.19	0.218	0.068	35911
82	6542	0.264	0.177	0.057	36860
83	6094	0.291	0.175	0.056	34743
84	9627	0.146	0.129	0.04	74483
85	9490	0.008	0.161	0.061	58904
86	7213	0.112	0.142	0.045	50799
87	7794	0.166	0.175	0.054	44450

AVERAGE C.V. FOR THE MEAN: 0.317

Table 16. ANOVA and coefficient estimates from the cod directed catch rate standardization.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.798
MULTIPLE R SQUARE...0.637

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	8.133E0003	8.133E0003	
REGRESSION	46	5.732E0002	1.246E0001	31.230
TYPE 1	14	3.419E0002	2.442E0001	61.207
TYPE 2	11	4.627E0001	4.206E0000	10.542
TYPE 3	21	1.081E0002	5.149E0000	12.905
RESIDUALS	818	3.264E0002	3.990E-001	
TOTAL	865	9.033E0003		

TYPE 1 - GEAR, TONNAGE CLASS, COUNTRY
TYPE 2 - MONTH
TYPE 3 - YEAR

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD.ERROR	NO.OBS
1	2112	INTERCEPT	-3.726	0.185	865
2	5				
3	66				
1	2113	1	0.734	0.068	213
	2114	2	1.415	0.109	58
	2122	3	1.286	0.372	3
	2123	4	1.131	0.093	73
	2124	5	1.582	0.143	28
	2212	6	1.641	0.081	116
	2213	7	1.747	0.081	118
	2222	8	1.885	0.294	5
	2223	9	2.008	0.097	62
	3113	10	1.854	0.282	6
	3114	11	1.445	0.154	24
	3123	12	1.662	0.397	3
	3124	13	1.935	0.650	1
	28121	14	0.935	0.353	4
2	1	15	-0.698	0.191	14
	2	16	-0.418	0.648	1
	3	17	-0.514	0.403	3
	4	18	0.502	0.096	70
	6	19	-0.139	0.083	108
	7	20	-0.241	0.089	90
	8	21	-0.083	0.088	93
	9	22	0.145	0.089	90
	10	23	0.168	0.085	104
	11	24	0.270	0.086	95
	12	25	0.354	0.102	61
3	67	26	-0.267	0.203	30
	68	27	-0.036	0.205	31
	69	28	-0.151	0.195	40
	70	29	-0.219	0.194	39
	71	30	-0.296	0.191	43
	72	31	-0.436	0.195	37
	73	32	-0.509	0.194	38
	74	33	-0.440	0.208	26
	75	34	-0.748	0.215	22
	76	35	-0.350	0.211	25
	77	36	-0.020	0.200	35
	78	37	-0.129	0.197	39
	79	38	-0.307	0.187	59
	80	39	-0.218	0.189	56
	81	40	-0.535	0.190	55
	82	41	-0.937	0.191	50
	83	42	-0.740	0.195	41
	84	43	-1.381	0.193	52
	85	44	-0.927	0.184	79
	86	45	-1.057	0.206	30
	87	46	-0.647	0.229	22

CODE: LAST TWO DIGITS EQUAL GEAR TYPE (10 - 19 ARE TRAWLERS, 20 - 29 ARE SEINERS) NEXT FROM THE LEFT EQUALS TONNAGE CLASS, THE FOURTH AND FIFTH DIGITS FROM THE LEFT ARE COUNTRY CODES.

Table 17. Standardized catch rate for cod directed fishery

PREDICTED CATCH RATE

Standard used variable numbers: 2112 5

YEAR	TOTAL CATCH	PROP.	CATCH RATE MEAN	CATCH RATE S.E.	EFFORT
66	11780	0.233	0.029	0.005	407437
67	9351	0.297	0.022	0.003	419259
68	9568	0.339	0.028	0.004	340557
69	8192	0.3	0.025	0.003	326559
70	9201	0.284	0.023	0.003	392347
71	9513	0.311	0.022	0.003	438213
72	8294	0.333	0.019	0.002	439736
73	7047	0.252	0.018	0.002	401845
74	8485	0.169	0.019	0.003	452463
75	8443	0.133	0.014	0.002	613577
76	11192	0.094	0.021	0.003	545716
77	9320	0.291	0.029	0.004	325991
78	9031	0.33	0.026	0.003	352011
79	10086	0.333	0.022	0.002	468765
80	8292	0.368	0.024	0.003	352684
81	7834	0.299	0.017	0.002	457772
82	6542	0.292	0.011	0.001	571783
83	6094	0.283	0.014	0.002	437501
84	9627	0.186	0.007	0.001	1310321
85	9490	0.288	0.012	0.001	819689
86	7213	0.1	0.01	0.001	712424
87	7794	0.079	0.015	0.002	512782

AVERAGE C.V. FOR THE MEAN: 0.130

Table 18. ANOVA and coefficient estimates from the plaice directed and cod directed combined catch rate standardization.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.846
MULTIPLE R SQUARE...0.715

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	8.086E0003	8.086E0003	
REGRESSION	41	1.072E0003	2.614E0001	65.756
TYPE 1	10	3.215E0002	3.215E0001	80.855
TYPE 2	1	2.831E0002	2.831E0002	712.079
TYPE 3	9	5.089E0001	5.655E0000	14.223
TYPE 4	21	1.116E0002	5.312E0000	13.361
RESIDUALS	1075	4.274E0002	3.976E-001	
TOTAL	1117	9.585E0003		

TYPE 1 - GEAR, TONNAGE CLASS, COUNTRY
TYPE 2 - MONTH
TYPE 3 - YEAR

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD.ERROR	NO.OBS
1	2122	INTERCEPT	-0.820	0.254	1117
2	2				
3	5				
4	66				
1	2112	1	-1.367	0.188	165
	2113	2	-0.601	0.185	247
	2114	3	-0.060	0.205	59
	2121	4	-0.256	0.259	12
	2123	5	-0.165	0.190	105
	2124	6	0.121	0.224	29
	2212	7	0.126	0.185	203
	2213	8	0.251	0.186	183
	2223	9	0.450	0.194	78
	3114	10	0.014	0.234	23
2	1	11	-1.395	0.052	847
3	1	12	-0.658	0.201	12
	4	13	0.471	0.085	87
	6	14	-0.145	0.073	141
	7	15	-0.279	0.076	124
	8	16	-0.124	0.076	128
	9	17	0.020	0.076	130
	10	18	0.094	0.074	140
	11	19	0.239	0.076	124
	12	20	0.354	0.097	65
4	67	21	-0.327	0.204	28
	68	22	-0.067	0.206	27
	69	23	-0.199	0.194	38
	70	24	-0.272	0.193	38
	71	25	-0.344	0.190	42
	72	26	-0.473	0.194	37
	73	27	-0.536	0.193	38
	74	28	-0.536	0.206	26
	75	29	-0.849	0.213	22
	76	30	-0.408	0.209	25
	77	31	-0.368	0.185	76
	78	32	-0.269	0.186	65
	79	33	-0.393	0.180	96
	80	34	-0.383	0.183	81
	81	35	-0.521	0.183	79
	82	36	-0.940	0.185	64
	83	37	-0.788	0.187	57
	84	38	-1.332	0.184	74
	85	39	-0.958	0.181	83
	86	40	-1.042	0.191	51
	87	41	-0.642	0.194	54

CODE: LAST TWO DIGITS EQUAL GEAR TYPE (10 - 19 ARE TRAWLERS, 20 - 29 ARE SEINERS) NEXT FROM THE LEFT EQUALS TONNAGE CLASS, THE FOURTH AND FIFTH DIGITS FROM THE LEFT ARE COUNTRY CODES.

Table 19. Standardized catch rate for combined plaice and cod directed fishery

PREDICTED CATCH RATE

Standard used variable numbers: 2122 2 5

YEAR	TOTAL CATCH	PROP.	CATCH RATE MEAN	S.E.	EFFORT
66	11780	0.233	0.520	0.130	22650
67	9351	0.292	0.378	0.084	24770
68	9580	0.298	0.489	0.110	19575
69	8192	0.296	0.430	0.093	19047
70	9201	0.282	0.400	0.086	23021
71	9513	0.309	0.372	0.079	25578
72	8294	0.333	0.327	0.071	25371
73	6905	0.257	0.307	0.066	22506
74	8485	0.169	0.306	0.069	27720
75	8443	0.133	0.224	0.052	37759
76	11193	0.094	0.348	0.079	32180
77	9230	0.736	0.365	0.071	25304
78	9031	0.673	0.402	0.081	22471
79	9996	0.618	0.356	0.069	28090
80	8292	0.567	0.359	0.070	23081
81	7834	0.487	0.313	0.062	25062
82	6542	0.555	0.206	0.041	31819
83	6094	0.574	0.239	0.049	25489
84	9599	0.322	0.139	0.028	69116
85	9490	0.296	0.202	0.040	46948
86	7213	0.196	0.185	0.038	38886
87	7794	0.202	0.277	0.053	28099

AVERAGE C.V. FOR THE MEAN: 0.211

Table 20. 4T plaice R.V. mean catch per tow adjusted (Prince*1.8)

AGE	1971	1972	1973	1974	1975	1976	1977
1	1.24	1.04	0.88	0.82	0.48	0.00	0.71
2	8.41	8.16	7.14	16.56	4.58	5.23	5.63
3	26.07	14.66	23.35	57.59	22.79	52.49	80.11
4	43.52	33.63	32.56	116.32	85.16	175.19	228.75
5	41.88	32.68	37.79	97.87	159.00	257.07	312.34
6	43.55	36.62	29.36	80.00	81.14	202.69	183.02
7	45.03	42.02	24.69	52.60	62.77	96.91	121.98
8	27.44	28.91	27.33	40.63	39.77	42.43	53.74
9	9.50	13.15	21.39	45.37	28.44	38.05	21.81
10	6.65	7.74	9.52	27.72	19.16	26.51	14.65
11	5.89	3.67	5.05	12.39	14.70	17.88	8.67
12	3.79	3.53	3.87	4.04	4.31	11.82	5.93
13	2.78	1.83	3.16	3.37	2.40	7.03	3.68
14	2.36	1.17	3.58	3.42	1.85	3.65	2.13
15	1.45	0.51	1.94	2.44	1.11	1.58	1.19
16	1.22	0.64	1.48	1.24	1.07	1.37	0.32
17	1.07	0.16	1.34	0.60	0.15	1.44	0.44
18	0.47	0.16	0.59	0.54	1.09	0.55	0.13
19	0.12	0.06	1.65	0.17	0.58	0.04	0.60
20	0.36	0.06	1.68	0.35	0.92	0.66	0.12
1+	272.80	230.40	238.35	564.04	531.47	942.59	1045.95

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	0.00	0.08	2.64	2.76	1.69	2.94	0.22	1.36	3.76	0.55
2	1.30	1.37	7.13	14.65	13.81	11.96	2.78	6.66	3.72	5.83
3	10.26	6.81	35.17	29.90	14.49	29.46	5.13	17.39	13.24	11.73
4	83.33	66.07	80.13	72.80	18.18	35.37	23.95	22.11	32.01	23.32
5	110.19	181.36	90.62	97.81	34.73	43.37	32.29	41.75	28.52	30.25
6	122.79	163.86	113.05	115.73	30.03	42.15	30.48	37.40	43.28	31.45
7	113.10	184.15	79.65	125.42	44.95	31.36	27.54	27.01	26.82	33.05
8	74.98	138.53	64.02	72.78	61.72	50.35	25.84	20.37	15.55	15.58
9	24.63	63.76	33.11	49.09	32.29	47.79	23.77	17.54	10.52	12.07
10	15.92	32.86	17.42	25.68	21.50	27.65	28.18	13.12	6.66	9.54
11	8.39	18.31	10.55	11.67	9.06	27.48	10.46	17.89	8.90	6.78
12	4.27	9.89	5.84	5.65	3.98	14.04	8.97	18.47	13.98	5.91
13	4.67	6.05	4.10	3.25	2.05	5.85	4.23	15.31	9.54	2.41
14	1.53	5.57	2.15	2.04	2.21	2.86	1.60	7.78	11.04	2.84
15	1.41	2.94	0.90	1.47	1.24	2.28	1.61	3.19	3.82	1.09
16	0.55	2.14	0.46	1.29	1.25	1.23	0.65	2.99	2.34	0.78
17	0.32	0.53	0.36	0.42	0.96	1.22	0.55	2.08	2.45	0.53
18	0.14	0.69	0.11	0.17	0.39	0.90	0.53	1.60	2.61	0.27
19	0.14	0.38	0.14	0.36	0.51	0.33	0.41	0.73	0.60	0.20
20	0.28	1.01	0.18	0.38	0.44	0.58	0.61	2.42	2.34	0.42
1+	578.20	886.36	547.73	633.32	295.48	379.17	229.80	277.17	241.70	194.60

Table 21. Z at age for 4t plaice from rv results.
Age and year are for first age and year.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	-1.880	-1.928	-2.932	-1.721	-2.379	.000	-.604	.000	-4.479	-1.712	-1.611	-1.960	.056	-3.427	-1.005	-.438
2	-.556	-1.052	-2.088	-.319	-2.438	-2.729	-.601	-1.658	-3.246	-1.434	.011	-.757	.846	-1.833	-.687	-1.148
3	-.255	-.798	-1.606	-.391	-2.040	-1.472	-.039	-1.862	-2.465	-.727	.497	-.893	.207	-1.460	-.610	-.566
4	.286	-.116	-1.100	-.313	-1.105	-.578	.730	-.778	-.316	-.199	.740	-.869	.091	-.556	-.255	.057
5	.134	.107	-.750	.187	-.243	.340	.934	-.397	.473	-.245	1.181	-.193	.353	-.147	-.036	-.098
6	.036	.394	-.583	.243	-.178	.508	.481	-.405	.721	-.104	.946	-.043	.425	.121	.332	.270
7	.443	.430	-.498	.280	.391	.589	.487	-.203	1.057	.090	.709	-.113	.194	.302	.552	.543
8	.736	.302	-.507	.357	.044	.665	.780	.162	1.431	.266	.813	.256	.751	.388	.661	.253
9	.205	.323	-.259	.862	.070	.954	.315	-.288	1.298	.254	.826	.155	.528	.394	.969	.098
10	.595	.427	-.264	.634	.069	1.118	.557	-.140	1.136	.401	1.042	-.245	.972	.454	.388	-.019
11	.513	-.054	.223	1.057	.218	1.104	.708	-.165	1.143	.624	1.077	-.438	1.120	-.368	.246	.410
12	.725	.108	.139	.520	-.491	1.167	.239	-.347	.881	.585	1.012	-.386	1.200	-.535	.661	1.760
13	.864	-.670	-.076	.597	-.421	1.194	.879	-.177	1.036	.697	.389	-.332	1.295	-.610	.327	1.212
14	1.525	-.503	.385	1.127	.157	1.123	.411	-.657	1.821	.377	.502	-.035	.576	-.691	.712	2.312
15	.812	-1.057	.445	.821	-.217	1.588	.778	-.416	1.867	-.362	.167	.003	1.263	-.620	.310	1.590
16	2.037	-.736	.896	2.132	-.292	1.129	.002	.038	1.781	.090	.298	.018	.816	-1.170	.198	1.495
17	1.871	-1.309	.921	-.588	-1.311	2.404	1.188	-.752	1.547	.754	.069	.064	.845	-1.078	-.226	2.190
18	2.142	-2.305	1.229	-.072	3.217	-.086	-.084	-1.026	1.573	-1.160	-1.104	.164	.797	-.327	.983	2.585
19	.761	-3.420	1.539	-1.672	-.136	-.999	.758	-1.971	.769	-.970	-.200	-.126	-.615	-1.783	-1.165	.366

Table 22. Average Z's from rv result for 4T plaice.

AGE	1971-87	1971-79	1980-87
1	-1.370	-1.431	-1.822
2	-1.036	-1.430	-1.031
3	-0.762	-1.058	-0.752
4	-0.225	-0.372	-0.163
5	0.084	0.039	0.161
6	0.167	0.062	0.334
7	0.276	0.240	0.417
8	0.387	0.317	0.602
9	0.363	0.273	0.590
10	0.375	0.375	0.516
11	0.380	0.451	0.452
12	0.381	0.258	0.647
13	0.327	0.274	0.502
14	0.481	0.446	0.697
15	0.367	0.344	0.527
16	0.460	0.651	0.441
17	0.347	0.303	0.520
18	0.344	0.377	0.439

Table 23. Results of 'Leap Frog' projection for 1988 4T plaice catch.

AGE	CATCH	IN CATCH RATIO
5	34	-1.904
6	319	-0.147
7	161	0.362
8	336	0.819
9	232	0.431
10	373	0.382
11	542	0.476
12	487	0.413
13	574	0.419
14	719	0.121
15	872	0.211
16	776	-0.089
17	764	0.113
18	593	-0.533
19	575	-0.533
20	537	-0.120
21	333	0.071
22	153	-0.959
23	309	-0.320
24	120	-0.390
25	67	-1.398
26	98	-0.035
27	27	-2.668
28	81	-0.970
29	33	1.459
30	1	0.000

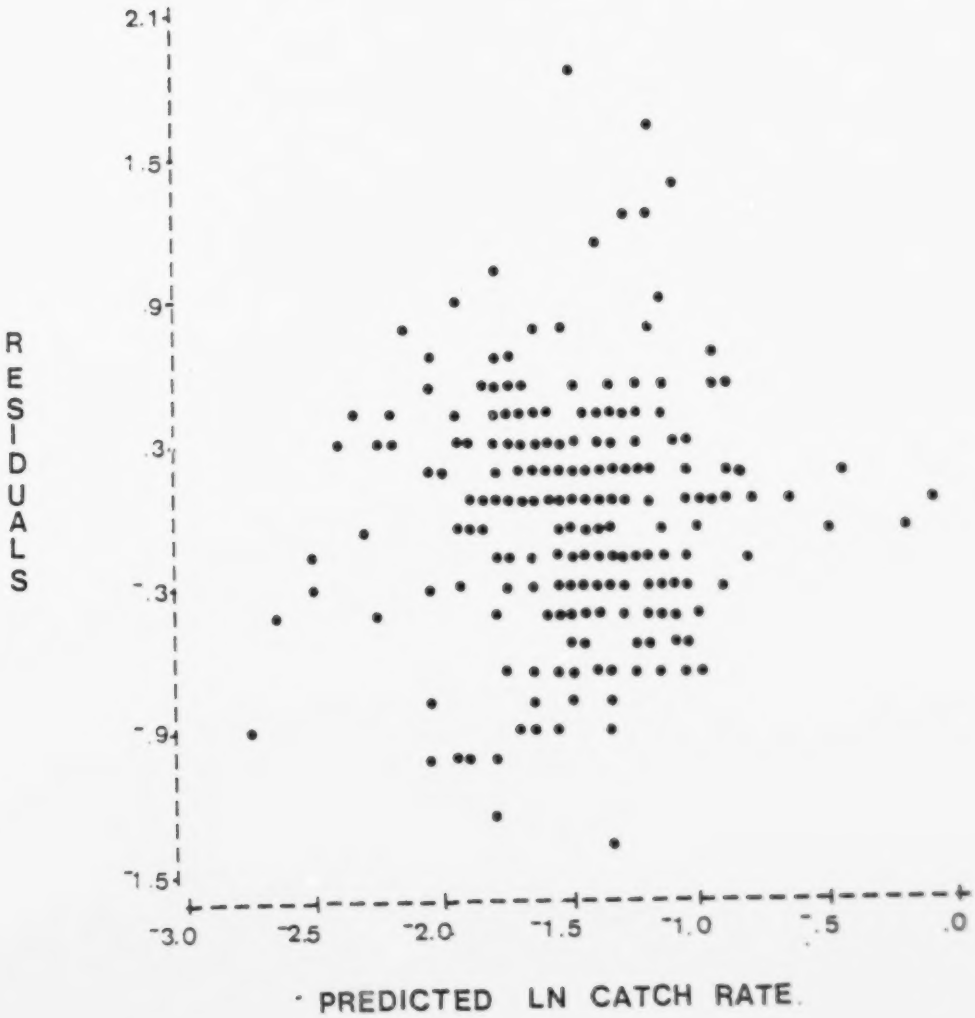


Figure 1a. Residuals versus predicted ln catch rate for the plaice directed run of the multiplicative model.

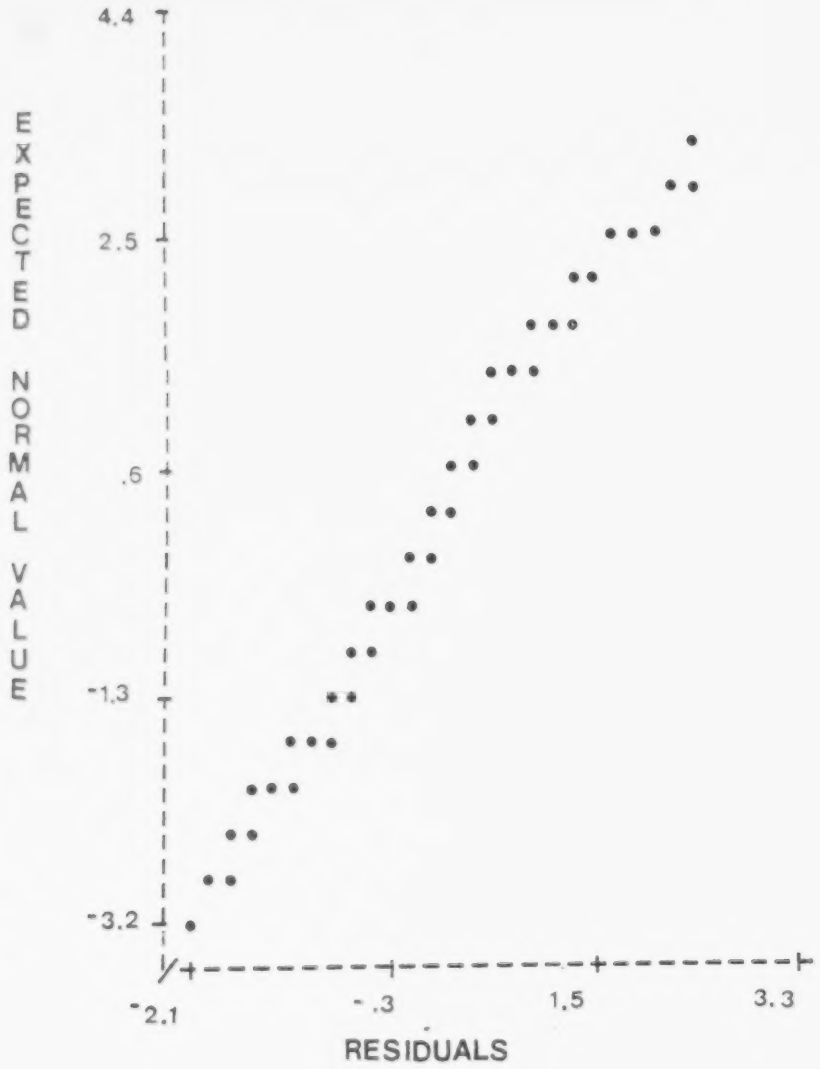


Figure 1b. Plot of normalized residuals of the plaice directed run of the multiplicative model.

Figure 2a. Residuals versus predicted ln catch rate for the cod directed run of the multiplicative model.

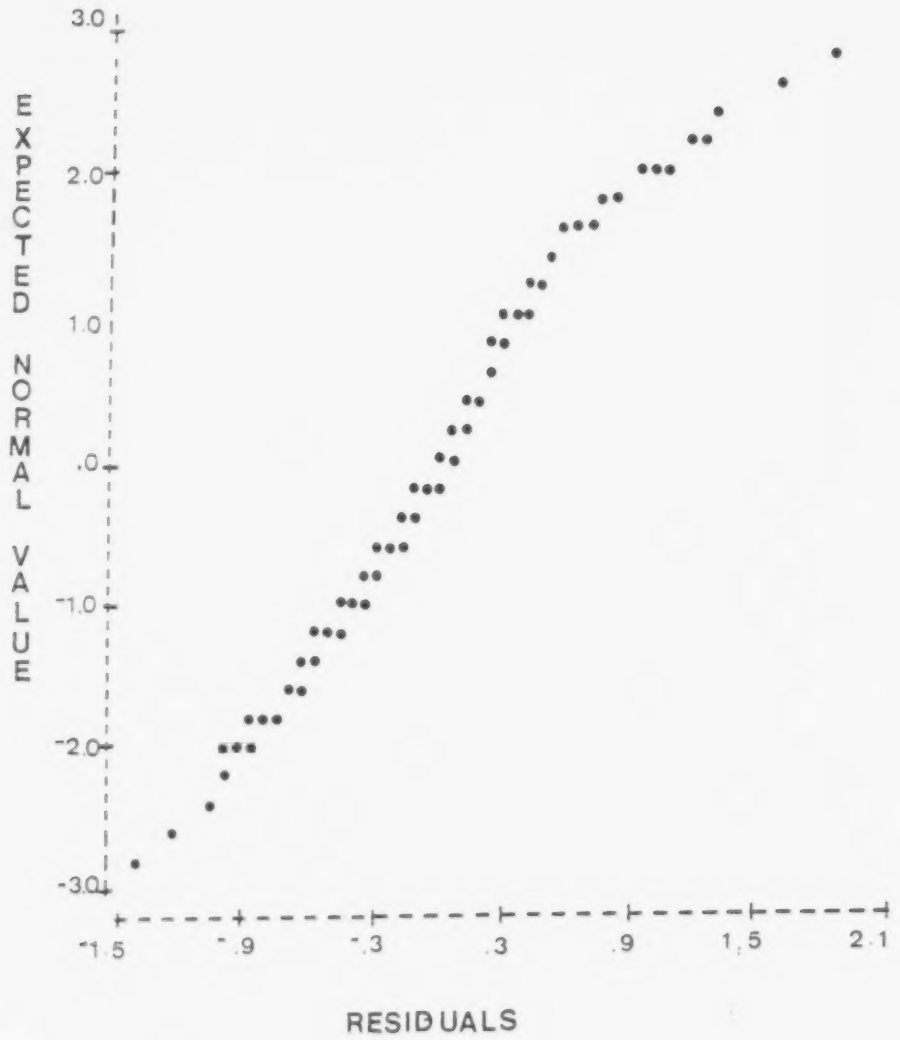


Figure 2b. Plot of normalized residuals of the cod directed run of the multiplicative model.

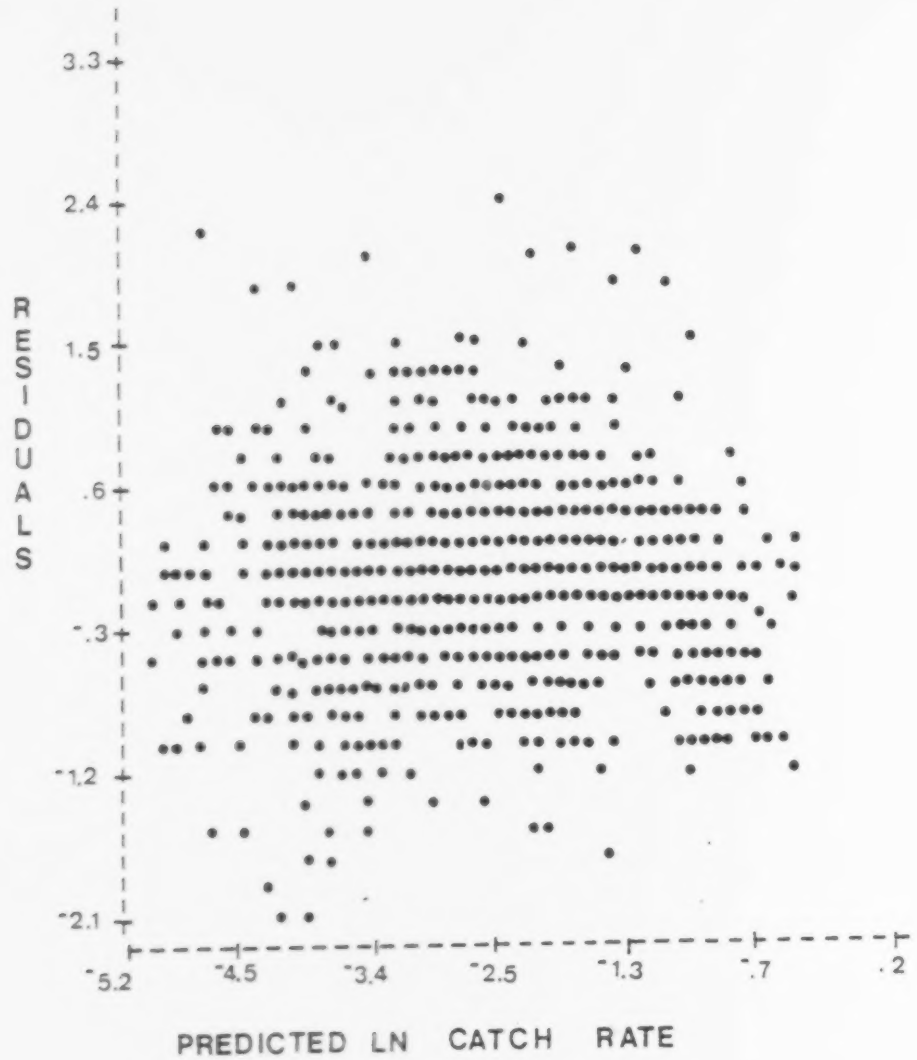


Figure 3a. Residuals versus predicted ln catch rate for the combined run of the multiplicative model.

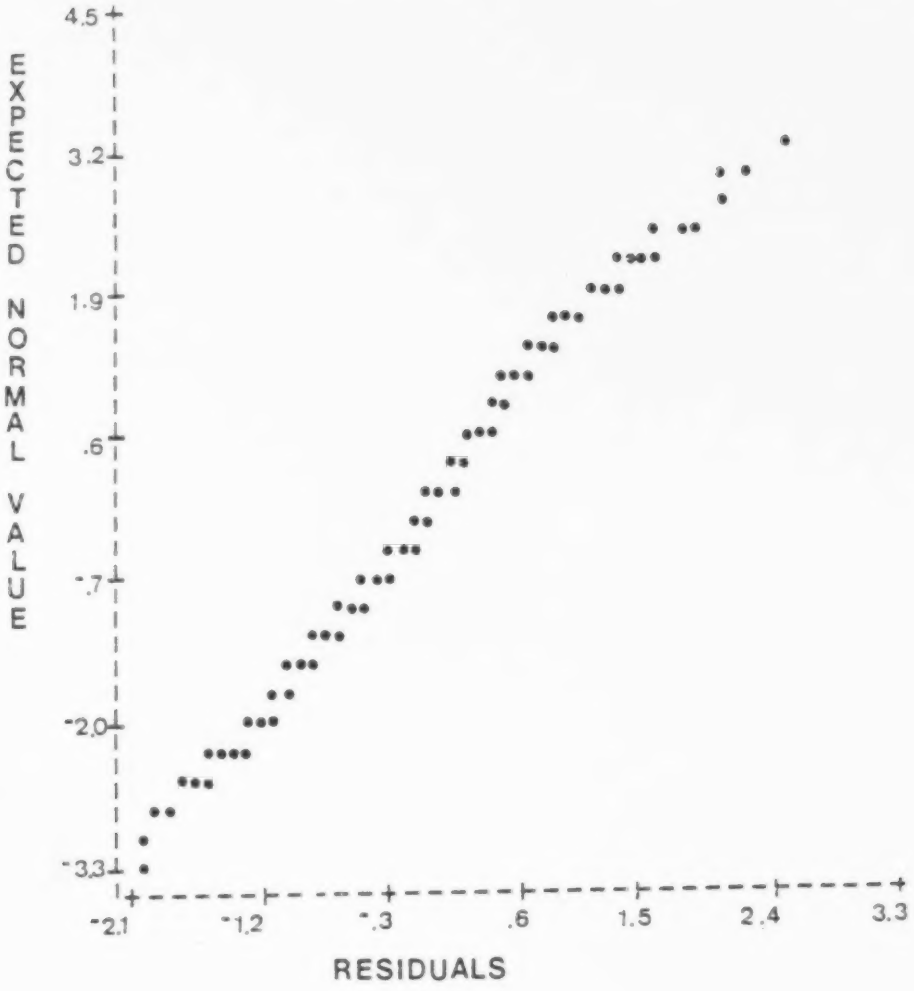


Figure 3b. Plot of normalized residuals of the combined run of the multiplicative model.

Figure 4. Catch per unit Effort for the plaice directed, cod directed and combined runs of the multiplicative model.

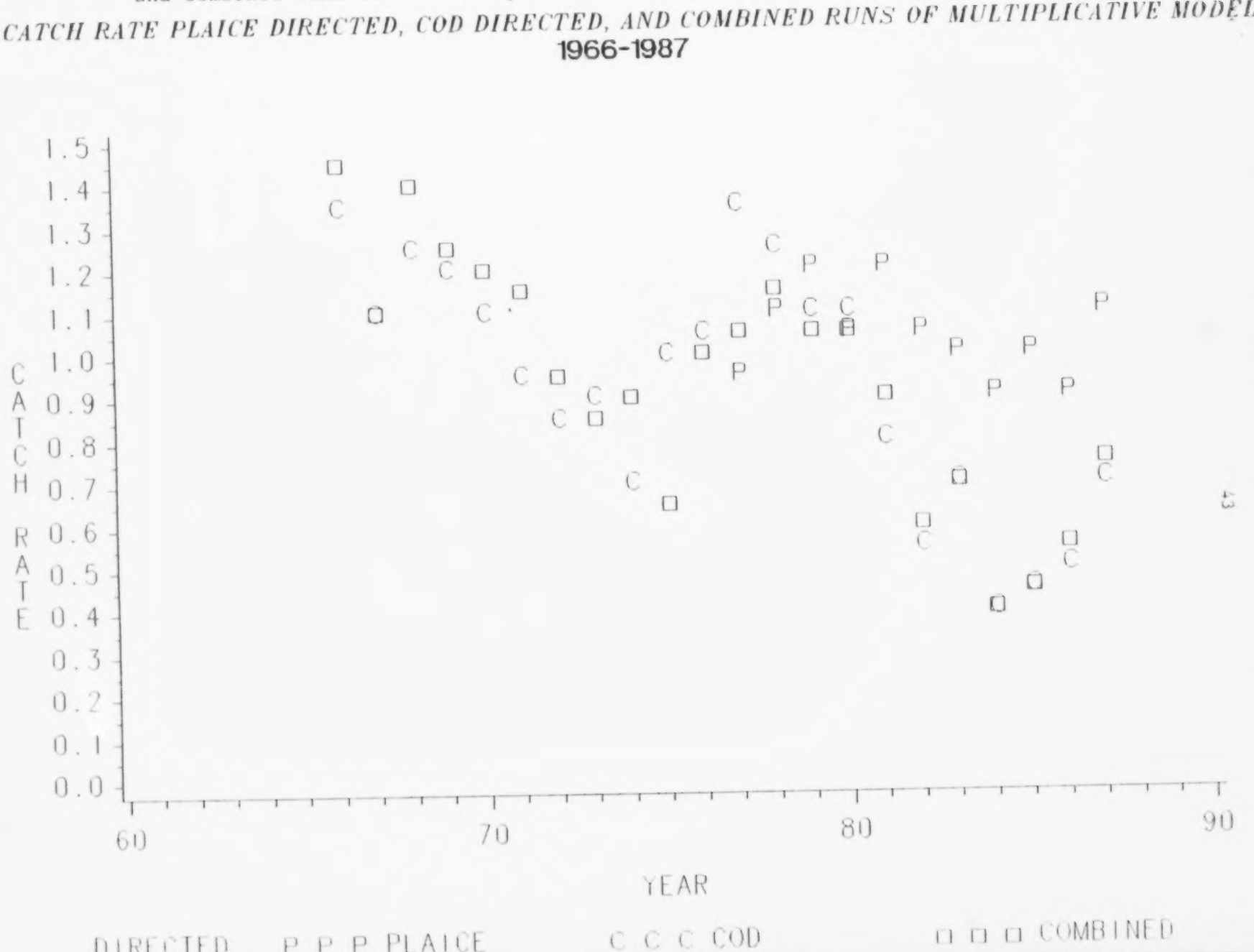


Figure 5. Efforts calculated by the plaice directed, cod directed and combined models derived from the multiplicative model.

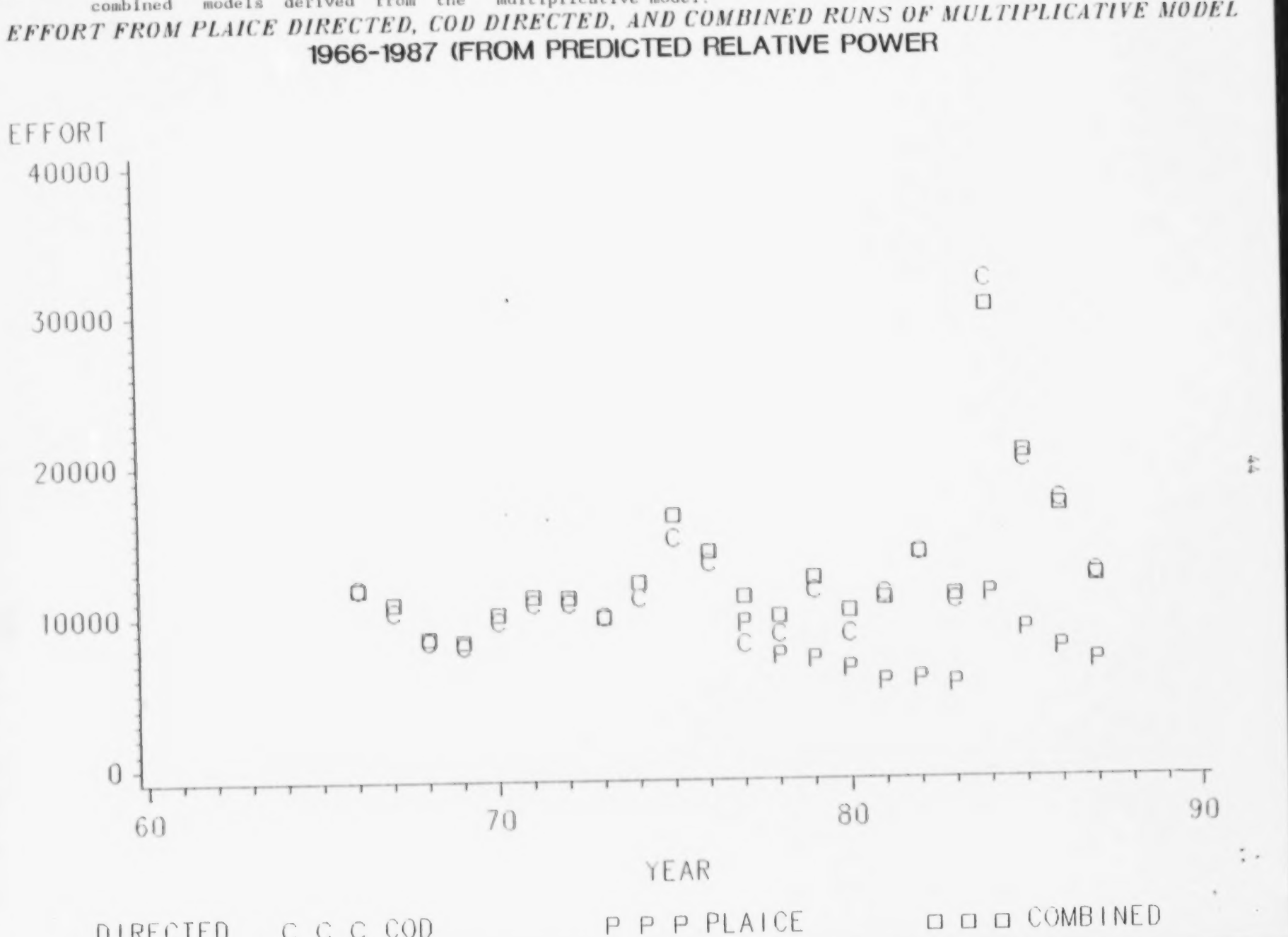
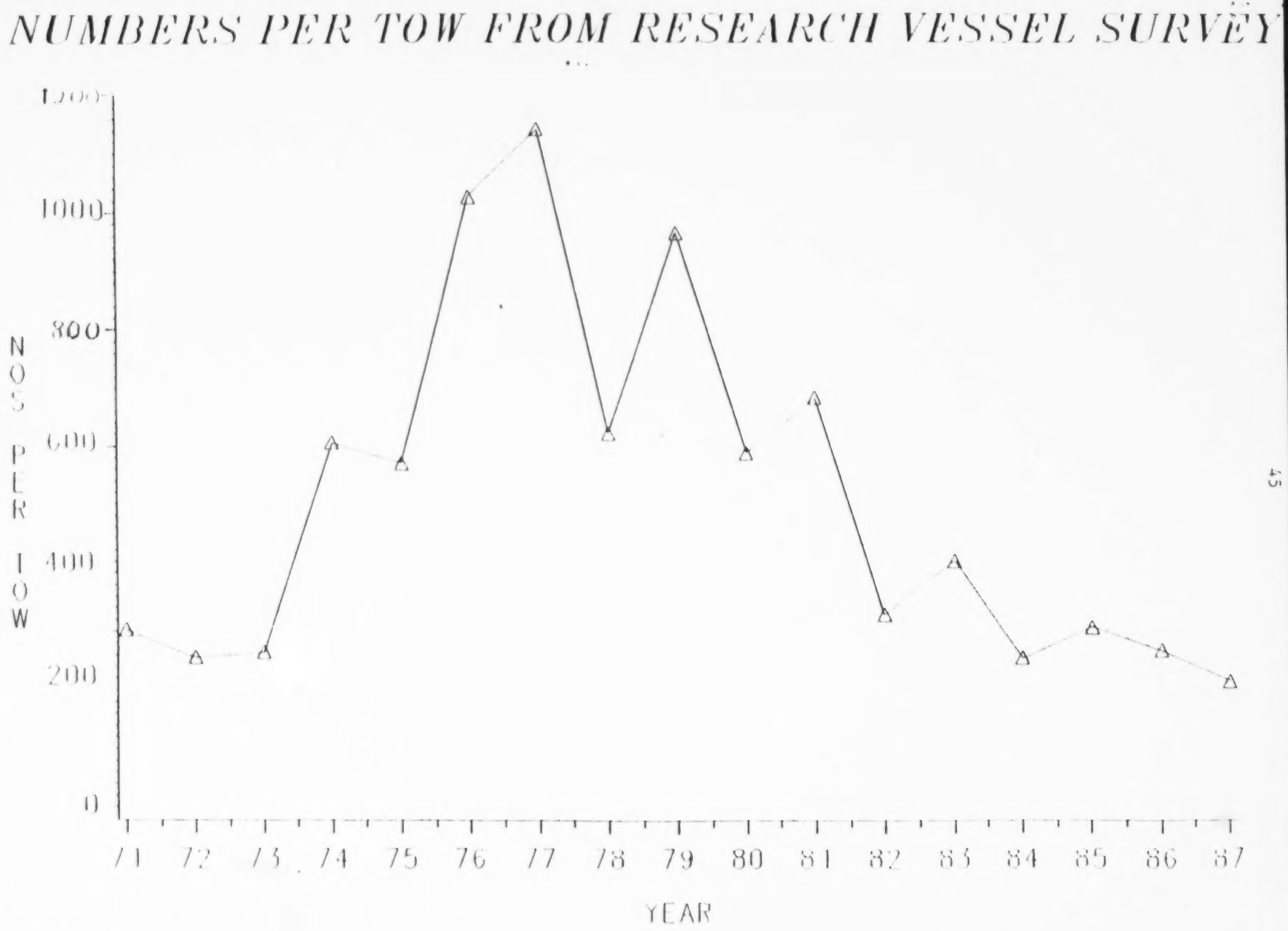


Figure 6. Mean number per tow from research vessel survey.



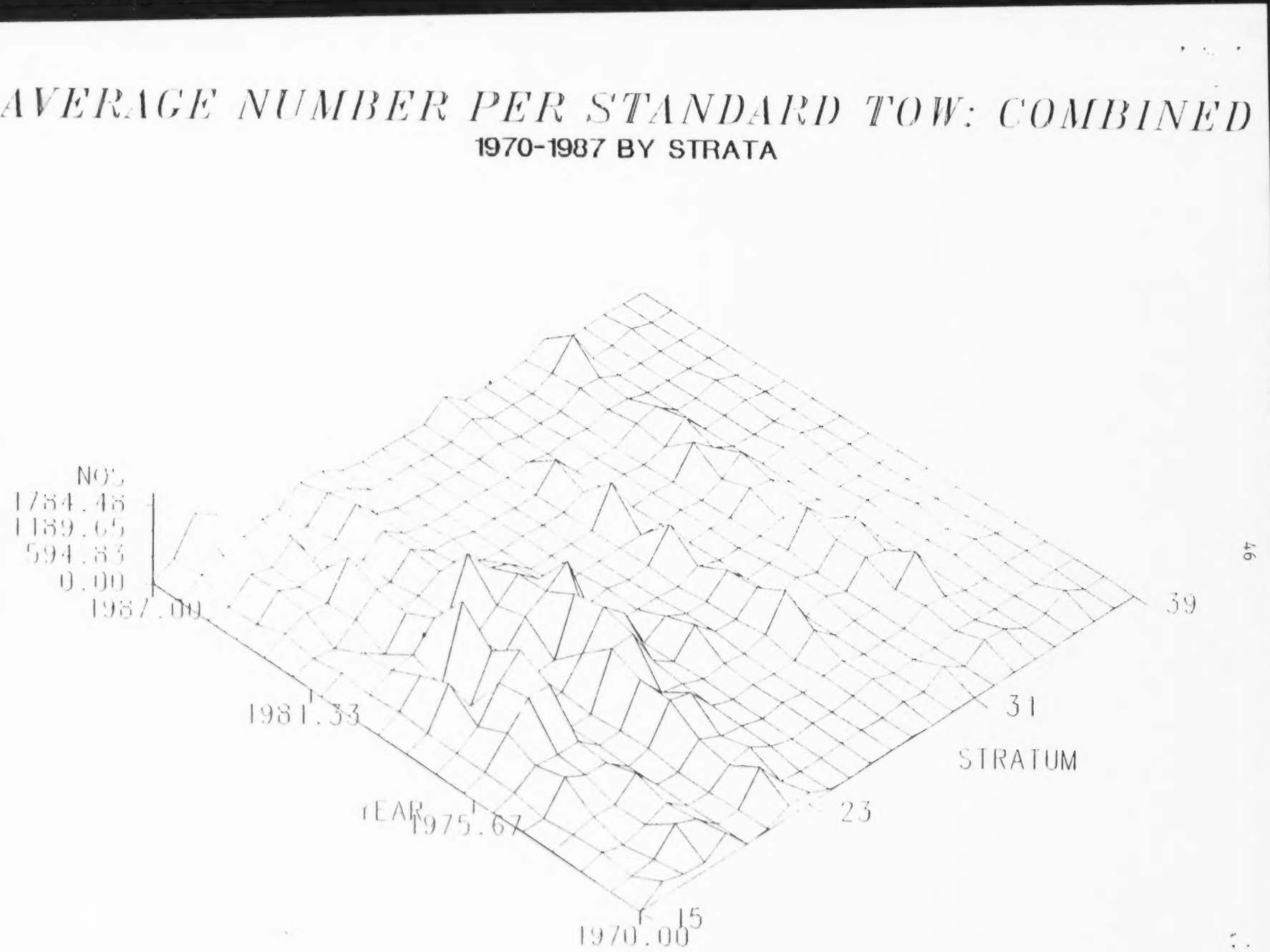


Figure 7. Mean number per standard tow - sexes combined by year and by stratum.

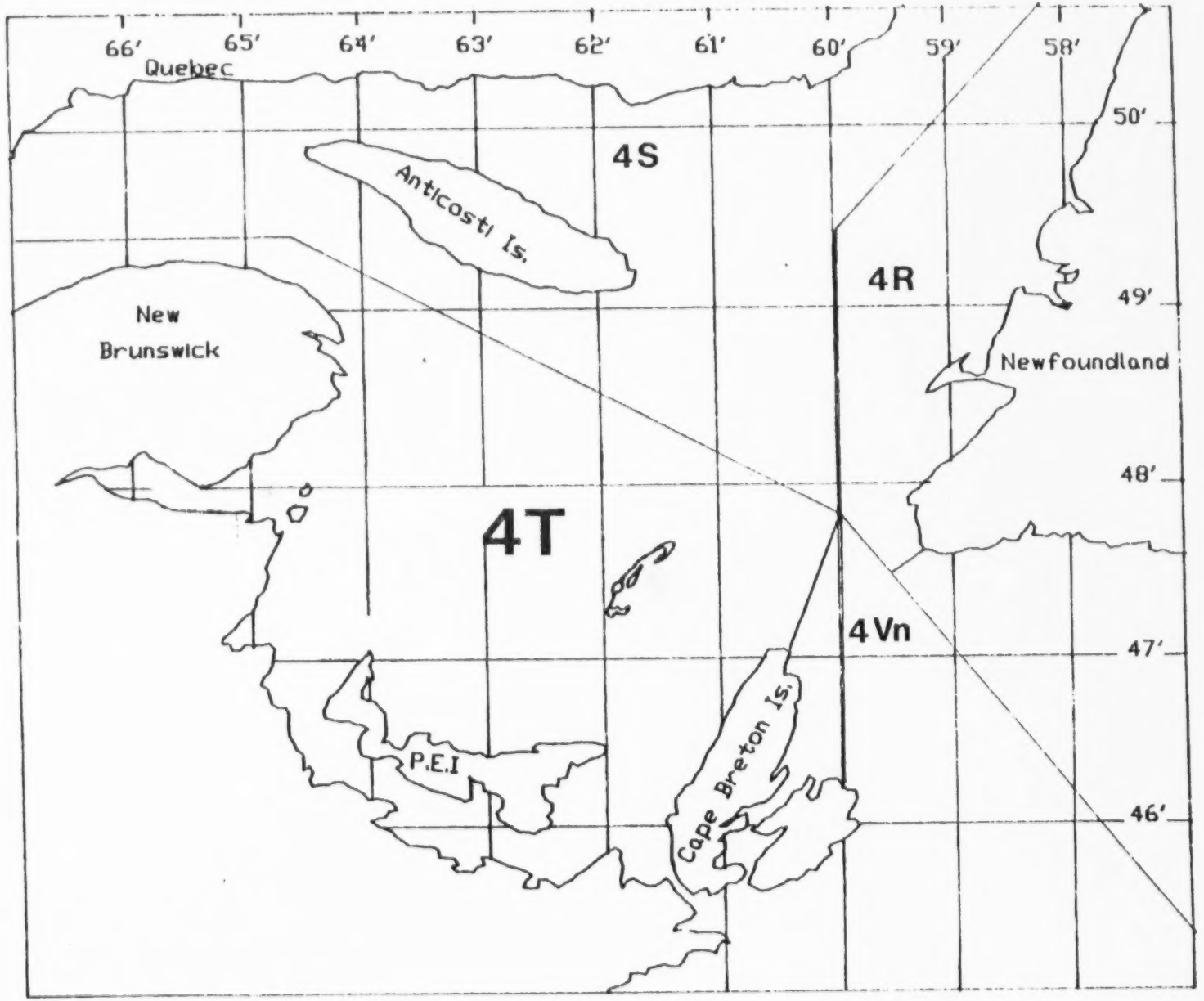


Figure 8. N.A.F.O. areas 4T, 4R, and 4S.